DOCUMENT RESUME

ED 445 905 SE 063 931

AUTHOR Lin, Sunny S. J.; Tsai, Chin-Chung
TITLE Teaching Efficacy along the Development of Teaching Expertise among Science and Math Teachers in Taiwan.
PUB DATE 1999-00-00
NOTE 9p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (Boston, MA, March 28-31, 1999).
PUB TYPE Reports - Research (143)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Secondary Education; Foreign Countries; Higher Education; Mathematics Education; Mathematics Teachers; *Pedagogical Content Knowledge; Science Teachers; *Self Efficacy; *Teacher Effectiveness
IDENTIFIERS *Taiwan

ABSTRACT

For many teacher education programs, the development of the effective teacher is one of their primary goals. Research has shown that teachers' sense of efficacy is a significant indicator of effective teacher teachers. This study attempts to reveal novice, beginning, and expert science and mathematics in-service or pre-service teachers' pedagogical knowledge and how the teachers' knowledge is related to their sense of efficacy. The expert and beginner teachers reported higher teaching efficacy than the novice teachers as measured by a formal psychological scale. The experts and beginners also related more teaching efficacy-related statements than novices. (Contains 33 references.) (ASK)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 445 905

Teaching efficacy along the development of teaching expertise among science and math teachers in Taiwan

Sunny S. J. Lin

Chun-Chung Tsai

Center for Teacher Education

National Chiao Tung University

Ta Hsueh Rd., HsinChu, Taiwan 300

FAX: 886 (3) 573-8083

Email: sunnylin@cc.nctu.edu.tw, cctsai@cc.nctu.edu.tw

*This article is based on a study funded by National Science Council, Taiwan.

NSC 87-2413-H-009-001

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Abstract

1

Introduction

For many teacher education programs the development of effective teacher is one of their primary goals. In achieving this goal, teacher training should enhance both cognitive and affective development. During career development, teacher's theoretical knowledge elaborates and translates into practice. However, knowledge alone cannot make a distinguished teacher.

Research has shown that teachers' sense of efficacy is a significant indicator of effective teachers (Brandt, 1986). Teacher's sense of efficacy shows the degree teachers believe their effort bringing about student learning and whether education system in general is effective. It is reasonable to expect that being an effective teacher one must construct more solid, well-structured pedagogical knowledge and in order to obtain such knowledge one should hold a higher sense of teaching efficacy. However, from past research we know little about relationship of teaching expertise (cognitive aspect) and teachers' sense of efficacy (affective aspect). Therefore, this study attempted to reveal novice, beginning, and expert teachers' pedagogical knowledge and how teachers' knowledge is related to their efficacy.

In this study, the authors are particular interested in science and math teachers' sense of efficacy because many Taiwan students, so as American students, feel frustrated or indifference about science or math. High ability students may have used least effortful strategies, such as rote memorizing, to deal with confusing science and math principles. Other lower capable ones may long have been lost in the woods so they simply deny learning. In such circumstance, teachers' sense of efficacy is even more important to their persistence in teaching.

This study adopted qualitative research method. Teachers were asked to view slides edited from real classroom activities and to think-out-loud what they perceived (Carter, Cushing, Sabers, Stein, & Berliner, 1988). From what teachers said the authors sketched their active pedagogical knowledge. Two sets of slides taken from either science or math classes were used as interview stimuli to match teachers' majors because it is not reasonable for math teachers to comment on science class events and vice versa. The invitation of participants across two subject matter areas may increase the external validity of the research. However two visual stimuli may become an interfering source in eliciting participants' responses. This is the limitation

http://www.aera.net/conference/linlae/linlae.htm

BEST COPY AVAILABLE

SE063931

of this study.

Teachers' Sense of Efficacy

Teacher's sense of efficacy has defined by Ashton and colleagues (Ashton, 1985; Ashton & Webb, 1986) as teacher's belief in their ability to produce effective student learning. In designing measurement for teacher's sense of efficacy, Gibson & Dembo (1984) using factor analysis extracted two dimensions: Personal Teaching Efficacy (PTE) and Teaching Efficacy (TE). Personal teaching efficacy refers to the belief of one's own teaching ability to bring about students' improvement. Teaching efficacy refers to the belief about the capacity of other teachers and educational system as a whole to help students.

Teacher's sense of teaching efficacy may influence several significant educational variables, such as student achievement (Gibson & Dembo, 1984), student motivation (Medgley, Feldlaufer, & Eccles, 1990), teachers' attitude toward innovation (Guskey, 1988), superintendents' evaluation of teacher performance (Trentham, Silvern, & Brogdon, 1985), and teachers' classroom management strategies (Ashton & Webb, 1986).

Some factors assumed to be predictors of teaching efficacy are: (1) background variables, e.g. gender and teaching experience; (2) class variables, e.g. class size and student achievement; (3) school variables, e.g. principal leader style and teacher autonomy; (4) social-cultural variables, e.g. mass media influence and teachers' social status. However, no researcher proposes that a teacher's knowledge as an indicator of his or her sense of teaching efficacy or vice versa.

Different studies have revealed teachers' senses of efficacy for in-service teachers, student teachers, and pre-service teachers (Ashton & Webb, 1986; Gibson & Dembo, 1984; Hoy & Woolfolk, 1990; Woolfolk & Hoy, 1990). Ashton & Webb (1986) found that in-service teachers had a relative low sense of both personal and teaching efficacy. Hoy & Woolfolk (1990) reported that experience of student teaching brought down student teachers' general sense of teaching efficacy. After one year of student teaching, student teachers were less sure that education could overcome the limitations of home environment and family background. Whereas, student teachers' personal teaching efficacy were higher after student teaching. They became even more confident about their own abilities to enhance students' learning. In the same study, prospective teachers in teacher education programs reported high scores both in the sense of personal efficacy and general sense of teaching efficacy. Such results are in line with Weinstein's (1988) finding about prospective teachers' strong tendency of "unrealistic optimism".

Based on the scales of Rand Corporation's Change Agent Study (Berman & McLaughlin, 1977) and Gibson & Dembo (1984), a revised Chinese version were developed in Taiwan (Wang, 1991). Wang's study included 1679 elementary and secondary school teachers in Taiwan to test the reliability and validity of TTES. Teachers who were rated as more effective teachers by peers and administrators gained higher scores in TTES. Teachers with higher sense of efficacy can be described as: male, in a secondary and a smaller school, with master degree, maintaining positive interpersonal relationship with students, parents, peers, administrators, and principals, perceiving positive community influence toward education society, and satisfied with teachers' vocational status. In general, all secondary in-service teachers had relative moderate general sense of teaching efficacy and personal efficacy, about 3 in a scale of 5. Teachers with various teaching experiences (grouped as 5 years and less, 6-15 years, 16-25 years, and 26 years and more) showed no difference in their sense of teaching efficacy.

Expert and Novice Teachers' Differences

One way to understand what an excellent teacher knows is to compare novice and expert teachers' behaviors and cognitive processing. Results of research on expert novice difference (Borko & Livingston, 1989; Leinhardt, 1989; Leinhardt & Greeno, 1986; Livingston & Borko, 1989; Petterson, 1988; Peterson & Comeaux, 1987; Strahan, 1989; Swanson, O'Connor, & Cooney, 1990; Westerman, 1991; Wintzky, Kauchak, & Kelly, 1994) showed that expert and novice teachers see classroom events differently because they know differently. The knowledge that expert teachers bring into classrooms allows them to infer accurately and efficiently, to screen irrelevant information, to comprehend the meaning behind classroom activities.

Berliner and his colleagues (Carter, et al., 1988; Carter, Sabers, Cushing, Pinnegar, & Berliner, 1987; Saber, Cushing, & Berliner, 1991) found that expert teachers performed better at: 1) monitoring and comprehending classroom events, 2) interpreting instructional strategies, 3) hypothesizing reasons for behaviors, and 4) offering solutions for classroom problems. Expert teachers' excellent performance could be accounted for by their more sophisticated knowledge structure and reasoning skills. Expert teachers' knowledge structure was relatively more elaborate, interconnected, organized, and accessible than those of novices. Also they are more capable to come up with adequate strategies to solve classroom problems.

Teachers' Knowledge

Shulman (1986) and Sternberg & Horvath (1995) indicated that expert teachers must be well versed in their subject matter: this is content knowledge. To perform excellent instruction, expert teachers also need to know how to teach in general which is named pedagogical knowledge. Keeping students engaged and checking their progress are examples of pedagogical knowledge. In addition to both content and pedagogical knowledge, expert teachers have so-called pedagogical content-specific knowledge: integrated knowledge of what and how to teach for a specific topic. Pedagogical content-specific knowledge includes how to teach (e.g. offering an interesting case) certain students (e.g. average 9th graders) about a topic (e.g. proportion). Finally, expert teachers need practical knowledge—knowledge of how to practice teaching in a certain social context. For example, teachers have to know most parents' expectation about their kids' education and how to ask parents' cooperation.

Experts and novices differ not only in the amount of knowledge they have but also in the manner in which knowledge is organized in memory (Sternberg & Horvath, 1995). Along with expertise growth, many excellent teachers may develop various teaching styles and knowledge. This is especially true when one looks into how different the winners of teaching awards are. Expert teachers may use a wide range of teaching or managing strategies in teaching any subject area to different levels of students. During implementation, expert teachers may flexibly decide to use alternatives cued by situations.

All these factors increase the difficulty to capture the fuzzy nature of experts' knowledge. However, in cognitive psychology, Rosch (1978) has proposed to form similarity-based category to solve this problem. The best way to sketch the central member or prototype of a category is to search the most commonly shared features among all valid members.

Lin & Li (1999) and Lin (1999) adopted such concept to reveal expert teachers' instructional knowledge. A small group of novices, beginners, and expert teachers in Taiwan were asked to view slides about natural sequences of instruction and freely comment. In this visual information processing, teachers' active instructional knowledge was categorized into ten aspects: lesson content and structure, task orientation, instructional variety, classroom management, learning climate, student outcome, teacher role, classroom context, issue related to general education system, issue related to community-school interaction. Experts shared some common features that (1) they adopted more high-level cognitive processing, such as evaluation and suggestion. (2) Their active instructional knowledge was richer and broader. (3) Their knowledge has been integrated to form many instructional strategies. Those strategies shared a pattern of if-then decision tree to treat individual differences in various situations. (4) Experts have personally tried or even examined (with action research) their instructional strategies in many years with different student groups. Therefore, they believed about the effectiveness of those strategies.

In general, previous novice-expert teacher studies have focused on teachers' knowledge and information processing. The authors in the analysis of teachers' expertise found it is very likely that teachers' instructional knowledge contain motivation statements. Moreover, teachers' motivation may be related to their instructional knowledge in career development.

Research Questions

This study intended to examine the relationship between teachers' pedagogical knowledge and their sense of teaching efficacy among expert, beginning, and novice teachers. Specifically, adopting a qualitative research method the goals of this study were to:

1. Reveal the role of teaching efficacy in teachers' pedagogical knowledge and visual information processing, and

2. See if teachers with various teaching expertise hold different teachers' sense of efficacy.

Research Methods

Participants

All participants were science and math in-service or pre-service teachers and were selected to form three groups: novice, beginning and expert teachers. Novices in this study were twelve pre-service teachers who were currently in teacher education programs in two research universities in Taiwan. They all maintained outstanding achievement both in their major departments and teacher education programs. The beginners were eight outstanding student teachers in their first year of student teaching.

who graduated from the same universities. Seven expert teachers with an average about 11 years of teaching were recommended by professors of teacher education programs through observations of their instruction. In addition, they have served as either senior teaching consultants in their school districts or as chairs of the science or math teaching committees in their schools. All of them have previously been cooperative teachers for some student teachers, though not necessarily for the beginners in the present study.

Measurement

In this study Taiwan Teaching Efficacy Scale (TTES, Wang, 1991) was adopted as the measurement for teachers' sense of efficacy. In TTES, there are two factors: personal teaching efficacy and general teaching efficacy. Though the factor names were similar to those in the previous studies (Gibson & Dembo, 1984), some differences deserved our particular attention. In TTES, both personal teaching efficacy factor and general teaching efficacy factor contains two subdimensions. First subdimension, teaching skills, concerns teachers' skills of planning lessons, selecting materials, and adopting teaching and management strategies to accommodate students' individual differences. Second subdimension, overcoming contradiction, draws teachers' opinion about external factors, such as family background, parental influences, mass media, and peers, that often exert contradict influences.

As the comparison, factors extracted from Gibson & Dembo do not contain subdimensions. Their personal teaching efficacy contains only the teaching skill subdimension of personal teaching efficacy in TTES. The teaching efficacy factor contains only the overcoming contradiction subdimension of general teaching efficacy in TTES. The factor difference between TTES and previous research is showed in Table 1.

The personal and general teaching efficacy factors possess 20 items each. Items in TTES were in a 5-point likert style, 1 as strongly agreed and 5 strongly disagreed. This scale showed good reliability index (total scalea = .90, personal efficacy a = .82, teaching efficacy a = .82).

Table 1: Comparison of factors and subdimensions of TTES and those in Gibson & Dembo (1984). In TTES, both personal teaching efficacy and general teaching efficacy possess two subdimensions (in columns). Whereas, in Gibson & Dembo personal teaching efficacy addresses only belief that one's teaching skills bring about students' learning. General teaching efficacy addresses only the belief that any teacher is capable to overcome contradiction from external environments (in gray rows).

		TTES	
		Personal Teaching Efficacy	General Teaching Efficacy
Factors in Gibson & Dembo (1984)	Personal Teaching Efficacy	Teaching Skills	Teaching Skills
	Teaching Efficacy	Overcoming Contradiction	Overcoming Contradiction

Procedures

One set of slides was taken to show consecutive events of a typical science class, the other a math class. One chapter period of either the science or the math classes in junior high level were videotaped by two camcorders for about a whole week. For both classes, six tapes were selected and edited into two sets of 128 digital slides, later displayed by Microsoft PowerPoint to the participants. These two sets of slides were selected to represent the events of a normal science or a math class including presentation of content, interaction among the teacher and students and within students groups, and involvement of students.

In the first experiment phase, participants from the expert, beginner, or novice groups were shown slides and asked to freely comment. The participants could stop the slides whenever they wished to comment. Their questions about classroom events were answered by the interviewers. The average length for the think-out-loud procedure of 27 participants was 81 minutes. At the second phase, they were asked to fill in Taiwan Teaching Efficacy Scale.

Data Analysis

Participants' comments were recorded and transcribed for analysis. The initial coding system, the content of comments contained eleven domains describing various aspects of instruction) was modified from Carter, et al. (1988) and Borich (1994). They are: lesson content and structure, task orientation, instructional variety, classroom management, learning climate, student outcome, teacher role, classroom context, issue related to general education system, issue related to community-school interaction, and other (Lin, 1999; Lin & Li, 1999). The authors first coded all protocols independently and the coding agreement was 0.81. Those sentences that were coded into different aspects were discussed until an agreement was reached.

After the initial coding, the protocols were read again to select sentences that were related to teachers' sense of teaching efficacy. The second coding system contained only two levels: teaching efficacy related and not related. The coding agreement was defined as the percentage of coding-agreed sentences in fifty sentences that were randomly selected from all protocols and it was 0.95.

Descriptive statistics were adopted to analyze each teacher's comment frequencies according to each coding system. Then the protocols were read again to select the prototype of each knowledge domain.

Results

Because of the small amount of participants in this study, the results of this exploratory study should be treated with cautious. With the same reason the significance test of group difference was not performed. In the analysis of quantitative data, both expert and beginning teachers reported higher teaching efficacy than the novice group (in Table 2). However in a closer look, personal teaching efficacy (PTE) displayed an increasing tendency along the development of expertise. In other words, experts have the greatest confidence that their personal abilities or efforts enhanced students' learning while novices the least. For general teaching efficacy (GTE), beginners gained higher than novices did, whereas experts dropped a little comparing with the beginners but it was still higher than novice group though.

Table 2: Means of subdimensions and factors of general teaching efficacy and personal teaching efficacy for novice, beginning, and Expert teachers.

Subdimension Means Factor Means **(Factor Means in 5-point scale)**		GTE**		PTE		Total
Novice	Overcoming Contradiction	34	67	33	61	128
N=12	Teaching Skills	33	*(**3.35**)	28	(**3.05**)	(**3.20**)
Beginner	Overcoming Contradiction	37	72	34	66	138
N=8	Teaching Skills	35	(**3.60**)	32	(**3.30**)	(**3.45**)
Expert	Overcoming Contradiction	34	69	34	70	139
N=7	Teaching Skills	35	(**3.45**)	36	(**3.50**)	(**3.48**)

*Number in the parentheses: factor or scale means transformed into 5-point scale.

**GTE: General Teaching Efficacy. PTE: Personal Teaching Efficacy

Expert teachers possessed more active instructional knowledge than beginners and novices (Experts 307, Beginners 268, and Novices 178). Teachers' instructional knowledge was further separated into two categories, teaching efficacy related and not related. Qualitative analysis (in Table 3) showed the same pattern as in the quantitative analysis. Experts articulated more teaching efficacy related statements than beginners and novices (Experts 37, Beginners 24, and Novices 12). Differences among three groups obviously showed in the knowledge aspects about Teacher Role and Issue Related to Community-School Interaction. In other words, when experts viewed instructional events, they made more teaching efficacy comments when they addressed (1) teacher's personality, teaching styles, colleague interaction, and professional growth, and (2) teacher parent interaction or any

community-school relationship.

Table 3. Percentages of teachers' teaching efficacy-related instructional knowledge.

Aspects of Instructional Knowledge	Experts		Beginners		Novices	
	*TE %	Total %	TE %	Total %	TE %	Total %
Lesson Content And Structure	9.68	20.20	10.71	20.90	6.67	16.85
Task Orientation	12.07	18.89	10.91	20.52	9.09	24.72
Instructional Variety	10.26	12.70	5.71	13.06	3.45	16.29
Class Management	10.87	14.98	9.76	15.30	6.67	16.85
Learning Climate	11.11	8.79	12.50	8.96	13.33	8.43
Student Outcome	10.34	9.45	4.17	8.96	8.33	6.74
Teach Role	31.25	5.21	11.11	3.36	0.00	1.69
Class Context	0.00	4.56	0.00	6.72	0.00	8.43
Issue Related To General Education System	16.67	1.95	0.00	0.93	0.00	0.00
Issue Related To Community-School Interaction	30.00	3.26	28.57	1.31	0.00	0.00
Total	12.05	100.00	8.96	100.00	6.74	100.00
Total # of Instruction Knowledge	37	307	24	268	12	178

*TE %: Percentage of teaching efficacy related statements of each aspect to total teaching efficacy related statements

Total %: Percentage of knowledge in each aspect to total instructional knowledge

For novice, exemplars for general teaching efficacy indicated that they were not unrealistic optimists about what general education system can do, as in Weinstein's study of American teachers. Their exemplars of personal teaching efficacy reflected their uncertainty in coming up with a strategy, less confidence about their suggestion of teaching practice, passive opinion about effects of teacher's efforts, and also more negative evaluation on what the teacher actors did in the slides.

Expert teachers commented on more domains of pedagogical knowledge as well as more details in each domain. Exemplars of the general teaching efficacy represented that experts put equal weights on teacher's own influence and external factors in bring about students' learning. Their exemplars about personal teaching efficacy showed their confident in every aspect of teaching practice, though some drew more on classroom management and some on dynamic relationship among content, task orientation, student outcome, and teacher per se. Their comments about the actor teacher were predominately encouraging and understanding the struggle to get through to most difficult students.

Conclusions and Discussions

The main finding of this study is that the expert and beginner teachers reported higher teaching efficacy measured by a formal psychological scale. In the qualitative analysis of teachers' instructional knowledge, the experts and the beginners also possessed more teaching efficacy related statements than novices. However, such result is not compatible with the findings of Woolfolk (1990) and Weinstein (1988). In their report, novices gained strong personal efficacy and general teaching efficacy. Whereas, after one year of student teaching beginners still maintained high personal teaching efficacy (believe their ability to promote student learning) but they became less sure about education in general can overcome contradiction from outside environments.

There are several possible reasons of this conflict. First, different measurement tools of teachers' sense of efficacy were adopted. Especially, the factor contents of Taiwan Teaching Efficacy Scale are very different from previous tools adopted in the

American studies. Second, cultural difference may play a role. In Taiwan, junior high school teacher position is still prestigious in the society because of ancient tradition that pays great respect to teachers. Before 1996, only few teachers colleges were allowed to trained teachers. When the ban was lifted, more than 30 universities set up teacher education programs recently. Each year they certificate 6000 more college graduates than before to compete few teaching jobs. Under such circumstance, it is reasonable that beginning teachers in Taiwan are strong both in self and general teaching efficacy. Finally, in this study the three groups of teachers, experts, beginners, and novices, are among the best comparing with their peers. It is very likely the best achiever may possess higher sense of teaching efficacy. Subjects in Woolfolk (1990) and Weinstein (1988) were randomly selected from pre-service or in-service teachers.

Findings of this study add complimentary sketch to previous study about Taiwan secondary teachers' sense of teaching efficacy (Wang, 1991). Wang found that teachers, no matter how long they teach, had moderate sense of teaching efficacy. In this study with limited sample size and pilot nature in mind, it is suggested with cautious that teacher's sense of efficacy plays an important role in the persistence of professional growth. Development of teaching expertise may require strong sense of teaching efficacy, especially personal efficacy. Or a well-constructed pedagogical knowledge must contain an important element.

References

Ashton, P. T. (1985). Motivation and teachers' sense of efficacy. In C. Ames & R. Ames (Eds.), Research on motivation in education: Vol. 2. The classroom milieu (pp. 141-174). Orlando, FL: Academic Press.

Ashton, P. T. & Webb, R. B. (1986). Making a difference: Teachers' sense of efficacy and student achievement. New York: Longman.

Berliner, D. C. (1986). In pursuit of the expert pedagogue. *Educational Researcher, 15*, 5-13.

Berman, & McLaughlin, (1977). Federal programs supporting educational change, Vol. II: Factors affecting implementation and continuation (Report no R 1589/7-HEW). Santa Monica, CA: Rand Corporation.

Borich, G. D. (1994). Observational skills for effective teaching. Englewood Cliffs, NJ: Macmillan.

Borko, H., & Livingston, C. (1989). Cognition and improvisation: Differences in mathematics instruction by expert and novice teachers. *American Educational Research Journal, 26* (4), 473-498.

Carter, K., Cushing, K., Sabers, D., Stein, P., & Berliner, D. C. (1988). Expert-novice differences in perceiving and processing visual classroom information. *Journal of Teacher Education, 39* (3), 25-31.

Carter, K., Sabers, D., Cushing, K., Pinnegar, S., & Berliner, D. C. (1987). Processing and using information about students: A study of expert, novice, and postulant teachers. *Teaching and Teacher Education, 3* , 147-157.

Gibson, S. & Dembo, M. H. (1984). Teacher efficacy: A construct validation. Journal of Educational Psychology, 76(4), 569-582.

Glickman, C. D. & Tamashiro, R. T. (1982). A comparison of first-year and fifth-year formal teachers on efficacy, ego development, and problem solving. Psychology in the Schools, 19, 558-561.

Guskey, (1988). T. R. Teacher efficacy, self concept, and attitudes toward the implementation of instructional innovation. Teaching and Teacher Education, 4, 63-70.

Hoy, W. K., & Woolfolk, A. E. (1990). Socialization of student teachers. American Education Research Journal, 27(2), 279-300.

Leinhardt, G. (1989). Math Lessons: A contrast of novice and expert competence. *Journal for Research in Mathematics Education, 20* , 52-75.

Leinhardt, G. & Greeno, J. G. (1986). The cognitive skill of teaching. *Journal of Educational Psychology, 78* (2), 75-95.

Lin, S. J. (1999). Looking for the prototype of teaching expertise: Qualitative research with mathematics teachers in Taiwan. (Manuscript submitted for journal review).

Lin, S. J. & Li, Y. (1999). Looking for the prototype of teaching expertise: An initial attempt in Taiwan. Paper presented at the annual meeting of the American Educational Research Association, Montreal, Canada.

BEST COPY AVAILABLE

Livingston, C. & Borko, H. (1989). Expert-novice differences in teaching: A cognitive analysis and implications for teacher education. *Journal of Teacher Education, 42* , 36-42.

Livingston, C. & Borko, H. (1990). High school mathematics review lessons: Expert-novice distinctions. *Journal of Research in Mathematics Education, 21* , 372-387.

Medgley, C., Feldlaufer, H., & Eccles, J. (1990). Change in teacher efficacy and student self- and task related-beliefs in mathematics during the transition to junior high school. Journal of Youth and Adolescence.

Peterson, P. L. (1988). Teachers' and students' cognitive knowledge for classroom teaching and learning. *Educational Researcher, 17*, 5-14.

Peterson, P. L., & Comeaux, M. A. (1987). Teachers' schemata for classroom events: The mental scaffolding of teachers' thinking during classroom instruction. *Teaching and Teacher Education, 3* , 319-331.

Rosch, E. (1978). On the internal structure of perceptual and semantic categories. In T. E. Moore (Ed.), *Cognitive development and the acquisition of language* (pp. 112-144). New York: Academic Press.

Saber, D. S., Cushing, K. S., & Berliner, D. C. (1991). Differences among teachers in a task characterized by simultaneity, multidimensionality, and immediacy. *American Educational Research Journal, 28* , 63-88.

Sternberg, R. J. & Horvath, J. A. (1995). A prototype view of expert teaching. *Educational Researcher, 24* (6), 9-17.

Strahan, D. B. (1989). How experienced and novice teachers frame their view of instruction: An analysis of semantic ordered trees. *Teaching and Teacher Education, 5* , 53-67.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher, 15* , 4-14.

Swanson, H. L., O'Connor, J. E., & Cooney, J. B. (1990). An information processing analysis of expert and novice teachers' problem solving. *American Educational Research Journal, 27* , 533-566.

Trentham, L., Silverman, S., & Brogdon, R. (1985). Teacher efficacy and teacher competence ratings. Psychology in School, 22, 343-352.

Wang, S. R. (1991). Teachers' sense of efficacy and its influential factors. Unpublished doctoral thesis, Taiwan Normal University.

Weinstein, C. (1988). Pre-service teachers' expectations about the first year of teaching. Teaching and Teacher Education, 4,31-40.

Westerman, D. A. (1991). Expert and novice teacher decision making. *Journal of Teacher Education, 42*, 292-305.

Wintzky, N., Kauchak, D., & Kelly, M. (1994). Measuring teachers' structural knowledge. *Teaching and Teacher Education, 10* (2), 125-139.

Woolfolk, A. E. & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. Journal of Educational Psychology, 82(1), 81-91.

BEST COPY AVAILABLE